Docket No.: 3449-0567PUS1
(Patent)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application of:	Hyo-Kun SON		
Application No.:	10/564,486	Confirmation No.:	9185
Filed:	January 13, 2006	Art Unit:	2811
For:	LIGHT EMITTING DEVICE AND MANUFACTURING METHOD OF THE SAME	Examiner:	Jesse Y. Miyoshi

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
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Sir:

The following comments are provided to assist the USPTO in evaluating the claims pending in the above-identified application. Applicants independent claims recite, *inter alia*, a super lattice structure including InGaN having a plurality of pits formed thereon, "***wherein a non-zero number of the plurality of pits is 50 or less per area of 5μm×5μm.***"

As seen in Fig. 1 below, a conventional N-type GaN layer generally has no pits.

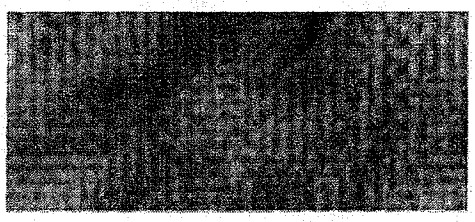


Fig. 1

In contrast, it is possible to create a super lattice structure including InGaN that has pits. The number of pits in a given area may be controlled during manufacture. In the claimed invention, there is a plurality of pits on the InGaN/InGaN multi-layer. The number of the pits is between 1 and 50 per area of 5μm×5μm (see, e.g., Fig. 2 below).

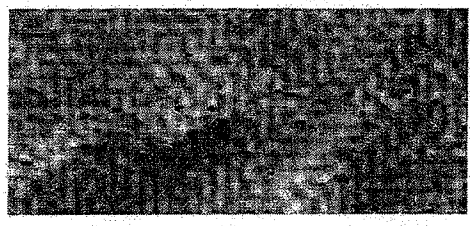


Fig. 2

However, it is also possible to create an InGaN/InGaN multi-layer, having a number of pits that is greater than 50 per area of 5μm×5μm (Fig. 3 below).

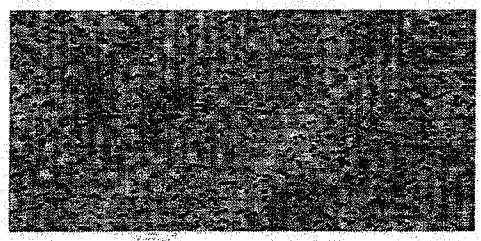
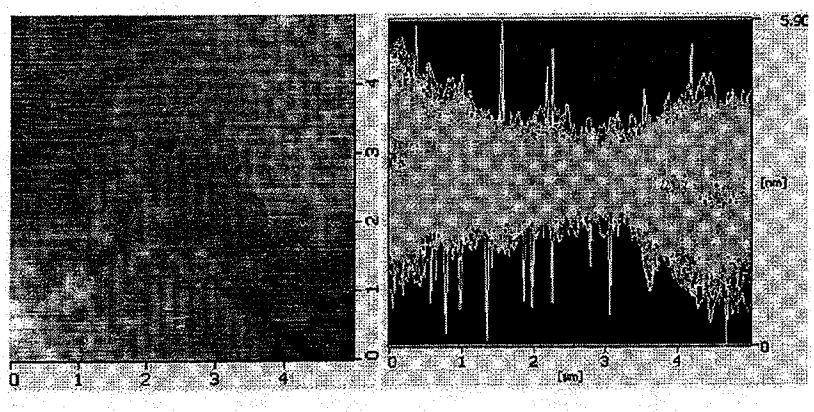


Fig. 3

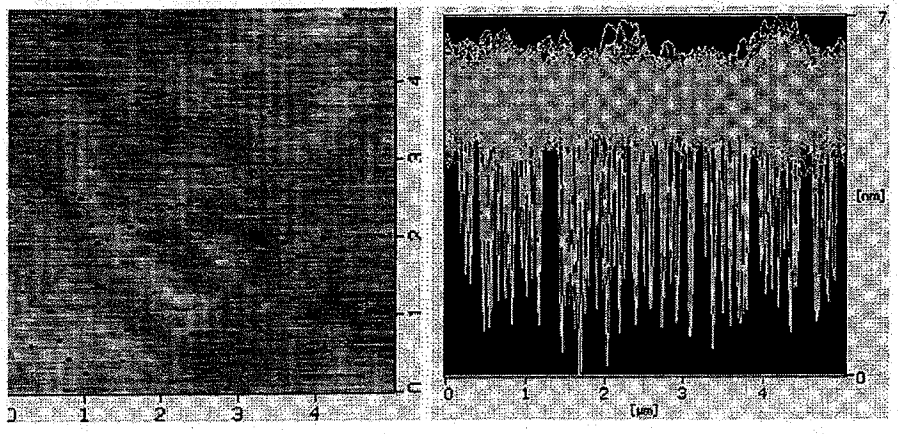
If the number of the pits is greater than 50 per area of 5μm×5μm, an active layer (e.g., a multi-quantum well (MQW) active layer) on the super lattice structure having the pits can be adversely affected. Applicant's test results show that, if the number of the pits is between 1 and 50 per area of 5μm×5μm, the active layer mostly fills the pits when the active layer is grown and has few pits of the surface thereof. Fig. 4 below is an atomic force microscope (AFM) image of an upper surface of Applicant's claimed active layer (i.e., an active layer on a super lattice structure including InGaN having a plurality of pits formed thereon, "***wherein a non-zero number of the plurality of pits is 50 or less per area of 5μm×5μm.***") Fig. 5 below is an AFM

image of a sectional view of Applicant's active layer. In Fig. 5, the green lines protruding in a lower direction corresponds to the number of pits, with the depth of pits represented by the length of the corresponding protruding lines.



Figs. 4-5

As shown in Figs. 4-5, Applicant's active layer has only a few pits on the upper surface thereof. However, Applicant's test results show that, if the number of the pits is greater than 50 per area of 5μm×5μm, the active layer cannot fill a large number of the pits when the active layer is grown. Thus, as seen Figs. 6-7 below, an active layer on a super lattice structure including InGaN having more than 50 pits per area of 5μm×5μm has many pits of the surface thereof.



Figs. 6-7

Fig. 8 below is a voltage-current graph of the LED when a low voltage or current is applied to the LED having an active layer and super-lattice structure according Figs. 4-5 (i.e., according to Applicant's claimed invention.)

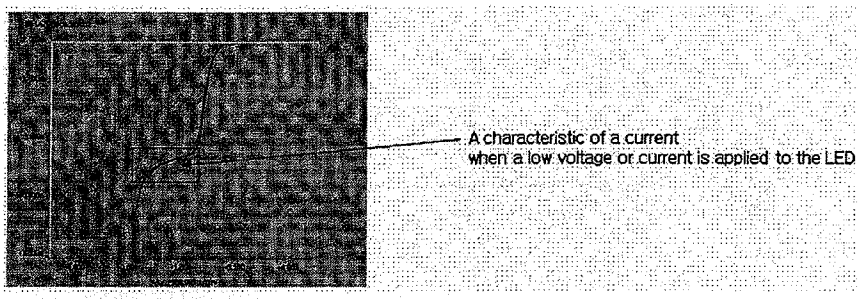


Fig. 8

As shown in Fig. 8, when a low voltage or current is applied to the active layer, a current characteristic detected at three points on the active layer is relatively constant, meaning that there is little or no damaging current leakage in the active layer. (Note - the lines of the graph in the red box are parallel to the X-axis (i.e., the lines slightly slant with the X-axis).

Fig. 9 below is a voltage-current graph of the LED is a voltage-current graph of the LED when a low voltage or current is applied to the LED having an active layer and super-lattice structure according Figs. 6-7.

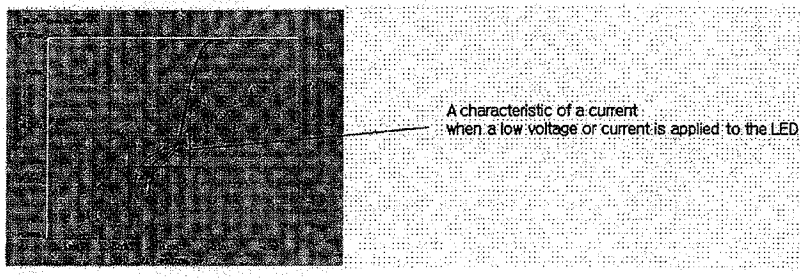


Fig. 9

As shown in Fig. 9, when a low voltage or current is applied to the active layer, the current characteristic detected at three points on the active layer is not constant. That is, the lines of the graph in the red box are divided, which means that there is damaging current leakage in the active layer.

In view of the preceding information, it is clear that the claimed invention is novel and useful. That is, by engineering the super lattice structure to have pits between 1 and 50 per area of 5μm×5μm, damaging leakage current can be avoided while other desirable properties may be obtained. Accordingly, Applicant's claimed active layer on a super lattice structure including InGaN having a plurality of pits formed thereon, "***wherein a non-zero number of the plurality of pits is 50 or less per area of 5μm×5μm***" is neither inherent nor a mere design choice.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on 2010. 04. 08.
Date

Executed by _____
Hyo-Kun Son